Aerosol transmission of SARS-CoV-2: inhalation as well as exhalation matters

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We read with great interest the article by Etchernach and colleagues(1) on the topic of aerosol dispersion during singing and speaking as a potential COVID-19 transmission pathway. In the article, as has been the case more broadly regarding this mode of transmission, attention has focused on factors that influence emission of virus (i.e. aerosol production by the infected individual) when singing or speaking. However, the ventilatory pattern of individuals exposed to aerosolised virus is also an important factor as this is likely to be a key modulator of the 'dose' of virus-containing aerosol inhaled. As such, inclusion of such parameters in discussion regarding aerosol transmission is important when considering why certain contexts such as choirs, restaurants, and bars, where speaking, singing and shouting are common, have been linked to infection clusters(2). Such an appreciation may reframe the discussion to include 'super-receptiveness' as a component of 'super-spreader' events.

Ventilatory parameters vary greatly depending on both the type and intensity of activity and should feature more prominently when considering aerosol transmission. We recently investigated the physiological demands of 'Singing for Lung Health' (SLH) in healthy volunteers(3), and found that when participating in the singing component of the protocol, minute ventilation increased from resting volumes of 11L/min (9-13) (median, interquartile range (IQR)) to 22.42L/min (IQR 16.83 - 30.54); and the median volume per breath increased from 0.69L (IQR 0.63 - 0.77) to 2.11L (IQR 1.92 - 2.70). Other researchers, comparing talking with quiet breathing, found increases in parameters including minute ventilation, tidal volumes, and breathing frequency(4, 5).

Both increased minute ventilation and increased tidal volume are likely to be relevant to aerosol transmission. Firstly, the more aerosolised viral particles inhaled the larger the inoculum, which will impact the chance of developing disease, and may also influence disease severity(6). Secondly, greater inhalation will increase the alveolar area exposed to virus containing aerosols which may have implications for the viral processing and the immune response(7).

Considering patterns of inhalation as well as exhalation should enable a more complete appreciation of context specific viral transmission dynamics. This is particularly relevant to contexts where minute ventilation is increased due to physical activity (gyms supermarkets etc.), but also where groups of people are vocalising, such as choral singing, restaurants, bars, and sports crowds. Appreciating these factors does not change the fundamental focus of mitigation measures of hygiene, face coverings, physical distance, and avoiding contexts with poor ventilation. However, given these considerations, particularly with new more infectious SARS-CoV-2 variants in circulation, there may now be a stronger argument for face coverings that reduce risk of inhaling aerosols rather than just reducing their emission, especially in contexts where people are vocalising, exercising, or other risk factors are present.

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